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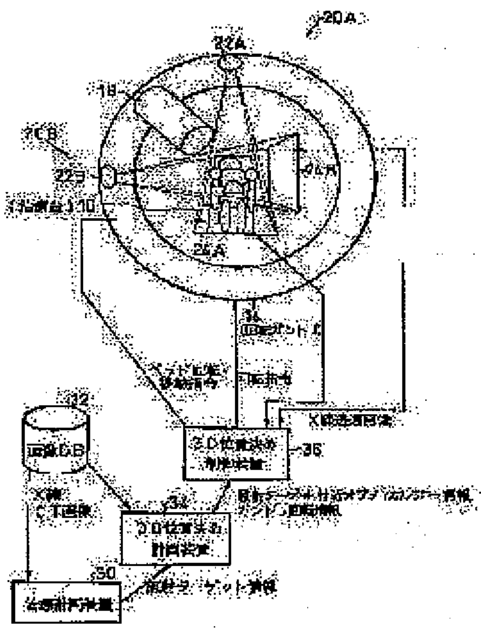
(54) METHOD AND DEVICE FOR MEASURING POSITIONAL DEVIATION OF PATIENT, METHOD AND DEVICE FOR POSITIONING PATIENT BY USING THE METHOD, AND RADIOTHERAPY APPARATUS

(57)Abstract:
PROBLEM TO BE SOLVED: To improve the precision in positioning by directly measuring the position of an irradiation target in a soft tissue which is difficult to discriminate.
SOLUTION: All the optical flows in the estimated range of the positional deviation of a patient are calculated in advance and this is compared with an actually measured optical flow to obtain the positional deviation of the patient.



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2.**** shows the word which can not be translated.
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CLAIMS

[Claim(s)]

[Claim 1]In a patient position gap instrumentation method for measuring the amount of gaps from a target position of a patient position, A patient position gap instrumentation method calculating beforehand all the optical flows of anticipation within the limits of the amount of patient position gaps, comparing this with an actually measured optical flow, and calculating a patient's amount of position gaps.

[Claim 2]The patient position gap instrumentation method according to claim 1, wherein it calculates the norm of a synthesized vector by said each calculated optical flow and this norm measures said actual optical flow near the standard norm used as the maximum.

[Claim 3]A patient position gap metering device characterized by comprising the following for measuring the amount of gaps from a target position of a patient position.
A preserving means which saves all the optical flows of anticipation within the limits of the amount of patient position gaps calculated beforehand.
A measurement means which measures a actual optical flow, and a matching means which compares a preservation optical flow saved at said preserving means with an actually measured measurement optical flow, and calculates a patient's amount of position gaps.

[Claim 4]The patient position gap metering device according to claim 3 calculating the norm of a synthesized vector by each optical flow calculated beforehand, having a means to ask for the standard norm from which this norm serves as the maximum, and measuring said actual optical flow near [the standard norm] this.

[Claim 5]A patient-positioning method characterized by positioning a patient according to the amount of position gaps calculated by the patient position gap instrumentation method according to claim 1 or 2.

[Claim 6]A patient-positioning device comprising:
The patient position gap metering device according to claim 3 or 4.
A patient-positioning control device which positions a patient according to the amount of position gaps calculated by this patient position gap metering device.

[Claim 7]A radiation therapy system comprising:
The patient-positioning device according to claim 6.
A radiation exposure device which irradiates with radiation a patient positioned by this patient-positioning device.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]The patient-positioning method by which a patient position gap instrumentation method, a device, and this were used for this invention, A device and a radiation therapy system are started and it is related with the patient position gap instrumentation method for measuring the amount of gaps from the suitable target position of a patient position to use for patient positioning of the radiation therapy by external irradiation especially, a device and the patient-positioning method using this, a device, and a radiation therapy system.
[0002]
[Description of the Prior Art]Since the focus which is an exposure target is generally correctly irradiated with radiation when performing radiation therapy by external irradiation, and radiation therapy which was excellent in dose localization especially, it is necessary to position a patient correctly.
[0003]The situation of patient positioning generally performed to drawing 1 by radiation therapy is shown.
[0004]As shown in drawing 2 on the occasion of patient positioning, it is Step 100 first, and in order to opt for exposure plans (treatment planning is called), such as the exposure numbers of oven chamber of radiation, a direction, and intensity, it is the X-ray CT photographing instrument 12, and the patient's 10 X-ray CT picture is photoed.
[0005]Subsequently, it progresses to Step 110, the position and size of the affected part with which it irradiates with the radiotherapy planning system 30 using said X-ray CT picture are grasped, and treatment planning which determines conditions (what is called an exposure parameter), such as the direction of radiation and thickness, is performed. A patient's body contour, setting out of a tumor field, and also input setting of the vital organ which must not irradiate with radiation are specifically performed using the photoed X-ray CT picture, and these three-dimensional models are created. Treatment planning is performed using this three-dimensional model and picture, and computer simulation determines the direction of radiation and an exposure dose. Since an exact exposure cannot be performed if the patient's position and posture on the X-ray CT used for the plan and a treatment table have shifted in the case of an exposure, patient positioning in the case of an exposure therapy serves as very important work which determines the success or failure of a therapy.
[0006]The false X-ray picture for patient positioning is created by computer simulation at Step 120 after the end of treatment planning. This false X-ray picture creates the 2-way from the patient upper part and the side, for example, and carries out record-keeping to a recorder.
[0007]Even this serves as advance preparations for an exposure therapy.
[0008]Subsequently, the work for patient positioning is done. This has two work of the positioning stage 140 at the prior positioning stage 130 and the time of an exposure, and prior positioning 130 is performed only once before an exposure therapy. In the external irradiation therapy of radiation, 20 to 30 times of fractionated irradiation are usually performed, but positioning 140 is performed for every exposure each time at the time of an exposure. Therefore, if this conducting positioning can be simplified, the burden of the both sides of an engineer and a patient can be reduced.
[0009]In said prior positioning stage 130, X-ray picture photography for positioning is performed at the time of an exposure, for example with marking to a patient's body surface (or patient fastener surface).
[0010]As shown in drawing 1, it is Step 132, the position of the patient 10 on the treatment table 16 in the rotation gantry 14 for a therapy is presumed roughly, and, specifically, the treatment table 16 is moved by the manual operation by viewing according to this (rough positioning is called).
[0011]Subsequently, progress to Step 134 and from the patient's 10 the upper part, the side, and 2-way. For example, radioparency photography is performed using the radioparency photographing instruments 20A and 20B which contain X-ray generators 22A and 22B and X ray imaging apparatus 24A and 24B, respectively, and the treatment table 16 is moved so that it may be in agreement with the false X-ray picture created at Step 120. If the treatment table 16 is moved, an X-ray picture will be photoed again and a result will be checked. This work is repeated if needed (a detailed position arrangement is called).
[0012]If both are in agreement, it will progress to Step 136 and record-keeping of the two radioparency pictures will be carried out to a recorder.
[0013]Subsequently, it is Step 138 and the marker projected on the patient body surface by the floodlight fixed to the irradiation equipment system, for example is transferred to a body surface or a fastener, for example in ink etc.
[0014]At the end, positioning 140 is performed to the degree of a actual exposure therapy at the time of an exposure. It is Step 142, and specifically, the treatment table 16 is moved by the manual operation by viewing so that the marker of a body surface and the projection marker by the floodlight fixed to the irradiation equipment system may be coincided (rough positioning is called).
[0015]Subsequently, at Step 144, radioparency photography is performed, and the treatment table 16 is moved so that it may be in agreement with the radioparency picture for positioning saved at Step 136. If the treatment table 16 is moved, a radioparency picture will be photoed again and a result will be checked. This work is repeated if needed (a detailed position arrangement is called).
[0016]
[Problem(s) to be Solved by the Invention]Although irradiated with radiation based on the exposure parameter determined by said treatment planning, Since the X-ray CT photographing instrument 12 and a therapeutic device (rotation gantry 14) are different devices, between the coordinate system of the patient 10 on the treatment table 16, and the coordinate system of an X-ray CT

picture used at the time of treatment planning, some gap will produce them. Therefore, in order to glare as treatment planning correctly at the affected part, it is necessary to amend a gap of this coordinate system. If the amount of gaps can be measured correctly, amendment of a patient position is possible by the treatment table 16 of 6 flexibility, for example.
[0017]In the detailed position arrangement of said steps 134 and 144, the patient position is measured using the radioparency picture. Although it is comparatively easy to recognize visually high-density substances, such as a bone, in a radioparency picture, distinction is difficult for the soft tissue of muscles or others. Therefore, although positioned by making into a landmark shape where the bone etc. which are usually in the neighborhood are characteristic, in a truncus part like a thorax or an abdomen, it had the problem that contrast was low and exact positioning was difficult.
[0018]This invention makes it the 1st technical problem to raise positioning accuracy, when it was made in order to solve said conventional problem, and distinction carries out direct measuring of the position of the exposure target in difficult soft tissue.
[0019]This invention raises the exposure accuracy of radiation and makes it the 2nd technical problem to ease the burden of the hospital side staff and a patient again.
[0020]
[Means for Solving the Problem]In a patient position gap instrumentation method for this invention to measure the amount of gaps from a target position of a patient position, All the optical flows of anticipation within the limits of the amount of patient position gaps are calculated beforehand, this is compared with an actually measured optical flow, and said 1st technical problem is solved by calculating a patient's amount of position gaps.
[0021]The norm of a synthesized vector is calculated by said each calculated optical flow, and as this norm measures said actual optical flow near the standard norm used as the maximum, it makes detection of an exposure target easy.
[0022]In a patient position gap metering device for this invention to measure the amount of gaps from a target position of a patient position again, A preserving means which saves all the optical flows of anticipation within the limits of the amount of patient position gaps calculated beforehand, Said 1st technical problem is solved by having a measurement means which measures a actual optical flow, and a matching means which compares a preservation optical flow saved at said preserving means with an actually measured measurement optical flow, and calculates a patient's amount of position gaps.
[0023]As the norm of a synthesized vector is calculated by each optical flow calculated beforehand, it has a means to ask for the standard norm from which this norm serves as the maximum and said actual optical flow is measured near [the standard norm] this, detection of an exposure target is made easy.
[0024]According to the amount of position gaps calculated by the aforementioned patient position gap instrumentation method, as this invention positions a patient, it solves said 1st technical problem again.
[0025]Similarly this invention solves said 1st technical problem in a patient-positioning device again by having the aforementioned patient position gap metering device and a patient-positioning control device which positions a patient according to the amount of position gaps calculated by this patient position gap metering device.
[0026]This invention solves said 2nd technical problem in a radiation therapy system again by having an above patient-positioning device and a radiation exposure device which irradiates with radiation a patient positioned by this patient-positioning device.
[0027]Said optical flow is saying what expressed a flow (motion) of a pixel on a picture with a vector, and usually asking for a motion of each inter-frame pixel of video by a vector, and it is used for detecting the move direction. The feature treats an instantaneous minute change at the moment, and if change is continuous, it will judge [being just going to change so that a motion of each pixel may flow, and] it. If a movement vector is detectable, grasp and pursuit of a movable matter object, and it being possible and using for a traffic census, recognition of human being's gesture, etc. are examined.
[0028]In this invention, three-dimensional positioning of an exposure target is performed using this optical flow.
[0029]
[Embodiment of the Invention]With reference to drawings, the embodiment of this invention is described in detail below.
[0030]The image database (DB) 32 which saves the X-ray CT picture required for radiation therapy photoed with the X-ray CT photographing instrument 12 shown in drawing 1 as the embodiment of the radiation therapy system concerning this invention was shown in drawing 3, The same radiotherapy planning system 30 as usual that takes out an X-ray CT picture from this picture DB32, performs the three-dimensional position and shape input, and dose distribution simulation of an exposure target, and determines the exposure parameter of radiation therapy, The optical flow information near [which was set up with this radiotherapy planning system 30] an exposure target, And the rotation information of the rotation gantry 14 for treating by irradiating the patient's 10 surroundings with radiation from the rotatable irradiation nozzle 18 is calculated, The three-dimensional (3D) positioning planning device 34 concerning this invention which transmits to the back appearance three-dimensional (3D) positioning control device 36, First, based on the gantry rotation information calculated with this 3D positioning planning device 34, perform radioparency photography, and collect those pictures, next an optical flow is calculated from this picture, It is constituted including the three-dimensional (3D) positioning control device 36 concerning this invention which calculates the gap with the optical flow information near an exposure target, and changes this into rotation and movement information of the treatment table 16, and these, It is connected to the network of a therapy system.
[0031]In said 3D positioning planning device 34, as shown in drawing 4, first at Step 200. The simulation of the picture of the radioparency photography currently performed by patient positioning in front of a therapy is carried out by one rotation (gantry angle of 0-360 degrees) at each set-up angle-of-rotation step (for example, 2 degrees), it is shown in drawing 5 -- as -- the radioparency simulation image XI from many gantries (n), and XI (n+1) ... is created. Although travel can be set up arbitrarily, if it is set, for example as 2 degrees, the radioparency simulation image of 180 sheets will be created.
[0032]Subsequently, the optical flow near [which was set up with said radiotherapy planning system 30 at Step 210] an exposure target is calculated between each simulation image. As shown in drawing 6, in the two adjoining radioparency simulation images X (n) and X (n+1), the equiluminance pixel in a certain infinitesimal area set as the same place specifically, By computing the movement vector between two pixels, assuming that the same thing moved, an optical flow is calculated and the optical flow picture O as shown in the right-hand side of drawing 6 is acquired. The arrow in a picture shows the movement magnitude and the direction of [between X (n) (n+1)]. Distinction of a motion is possible even if the contrast of muscles or others is low soft tissue.
[0033]Subsequently, as it progresses to Step 220 and is shown in drawing 7, optical flow vector of(i) near an image center and its norm (absolute value) are calculated, the greatest norm value is searched with each optical flow picture out of it, and it is considered as the standard norm XN (n) by it. The optical flow at this time is made into a standard optical flow, and a total of three information is saved together with the angle of rotation information which calculated this standard optical flow. Since it is thought that how depending on which an optical flow vector is large, and the picture near an exposure target is in sight has a big

change near the standard norm, if radioparency photography is performed using this angle of rotation information, it will become easy to detect an exposure target.

[0034]Said 3D positioning planning device 34 ranks second, and progresses to Step 230 of drawing 8, and it is the range of a patient setup error (for example, **30%) near [this] the angle of rotation. At Step 240, as shown in drawing 9, rotate and move an X-ray CT picture, also put in a bed angle and the degree of tilt angle, re-create the radioparency simulation image of a reference angle degree circumference infinitesimal area, and Rotation and movement magnitude (n). The optical flow at that time (n), (Step 250), and the norm (n) and (Step 260) of a synthesized vector are calculated, and it saves on a table. This preserved information is transmitted to said 3D positioning control device 36.

[0035]As said 3D positioning control device 36 is shown in drawing 10, the angle of rotation information and the angle-of-rotation step information which were outputted from said 3D positioning planning device 34 at Step 310 are used, A rotation gantry and a radioparency photographing instrument are controlled, radioparency photography is performed, and at Step 320, the measured optical flow is calculated as a measurement optical flow, and is saved. At Step 330, the norm of a synthesized vector is also calculated and it saves as the measurement norm.

[0036]Progress to Step 340 of drawing 11 and Subsequently, this measurement optical flow Ofm(i), Pattern matching with optical flow Ofm(i) saved as a table. It carries out by taking total PM of the inner product of the vector for every pixel which corresponds to drawing 12 so that it may be shown, and the value of matching outputs the rotation and movement magnitude which became the minimum (PM is the maximum) as an amount of gaps of rotation and movement.

[0037]In this embodiment, since radioparency photography is performed using the angle of rotation information near [which is considered that how where the picture near the exposure target is in sight has a big change] the standard norm, an exposure target is easily detectable with sufficient accuracy. Even if it is not near the standard norm, when sufficient accuracy is obtained, it is also possible to detect a position gap with other angle of rotation.

[0038]If high speed calculation becomes possible, the simulation in real time is also possible.

[0039]

[Effect of the Invention]According to this invention, since high-density substances, such as a bone, are not used instead but the exposure target itself is measured, the accuracy of positioning improves. Therefore, the exposure accuracy of radiation can improve and the burden of both the hospital side staff and a patient can be made to ease.

[0040]Actual radioparency photography can be managed at once and a patient's amount of contamination is reduced.

[0041]In particular, it is full automatic, and when it is made to position, dispersion for every operator can be prevented.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]The diagram showing the situation of patient positioning generally performed by radiation therapy
[Drawing 2]The flow chart showing the procedure of said patient-positioning work
[Drawing 3]The block diagram showing the entire configuration of the radiation therapy system with which this invention was adopted
[Drawing 4]The flow chart showing the first half of operation of the three-dimensional positioning planning device used by said embodiment
[Drawing 5]The perspective view showing signs that the simulation image is created from multi-gantry angular orientation, in said three-dimensional positioning planning device
[Drawing 6]The diagram showing signs that the optical flow is similarly calculated
[Drawing 7]The diagram showing signs that the characteristic quantity of an optical flow is similarly calculated
[Drawing 8]The flow chart showing the second half of operation of said 3D positioning planning device
[Drawing 9]The perspective view showing signs that the simulation image in a reference angle degree circumference infinitesimal area is created, in said 3D positioning planning device
[Drawing 10]The flow chart showing the first half of operation of 3D positioning control device used by said embodiment
[Drawing 11]The flow chart showing the second half similarly
[Drawing 12]The diagram showing signs that pattern matching of the optical flow is performed, in said 3D positioning control device
[Description of Notations]
10 -- Patient
12 -- X-ray CT photographing instrument
14 -- Rotation gantry
16 -- Treatment table (patient bed)
20A, 20B -- Radioparency photographing instrument
22A, 22B -- X-ray generator
24A, 24B -- X ray imaging apparatus
30 -- Radiotherapy planning system
32 -- Image database (DB)
34 -- Three-dimensional (3D) positioning planning device
36 -- Three-dimensional (3D) positioning control device
O -- Optical flow picture

[Translation done.]